

COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN No. 56.

# NURSERY FUMIGATION

AND

The Construction and Management of the Fumigating House.

By PROF. W. G. JOHNSON.



*PUBLISHED BY DIRECTION OF THE SECRETARY.*

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1899.

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WM. STANLEY RAY,  
STATE PRINTER OF PENNSYLVANIA.  
1900.



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COMMONWEALTH OF PENNSYLVANIA.

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HARRISBURG, PA., *December 30, 1899.*

The prevalence and destructive character of the San Jose Scale and other injurious insect pests and fungous diseases which threaten the destruction of our nurseries of fruit and ornamental trees, has caused great anxiety on the part of nurserymen and fruit growers in this State. The extreme importance of this subject demands that the public shall be protected from the spread of the scale and fungous enemies, dangerous to fruit growers, mentioned.

Prof. W. G. Johnson, Entomologist for the Maryland Experiment Station, who has had large experience in the use of the Fumigation method in controlling insects and protecting orchard trees from their ravages, was accordingly requested to prepare a short Bulletin upon the methods and appliances for fumigation which he has found to be effective in destroying insect life and which, at the same time, produces no injurious effect upon the stock subjected to the fumes of the gases used.

This Bulletin is in answer, therefore, to this request, and is commended to the attention and confidence of all nurserymen and fruit growers as being the result of experience and careful observation by one of our most capable Entomologists.

JOHN HAMILTON,  
Secretary of Agriculture.



MARYLAND AGRICULTURAL COLLEGE,

COLLEGE PARK, MD., *December 28, 1899.*

Hon. John Hamilton, Secretary of Agriculture, Harrisburg, Pa.:

Dear Sir: In accordance with your request, I submit you herewith copy for a Bulletin on Nursery Fumigation, with illustrations.

Very truly yours,

(Prof.) W. G. JOHNSON,

State Entomologist.



# NURSERY FUMIGATION AND THE CONSTRUCTION AND MANAGEMENT OF THE FUMIGATING HOUSE.

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## INTRODUCTORY.

It would be useless to enter into a detailed discussion of the conditions that have made it necessary to have a guarantee certificate accompany each consignment of nursery stock. Suffice it to say, that since the discovery of the San Jose Scale in Eastern United States, in August, 1893, and the publication and general distribution of so much literature on that insect since then, public sentiment has been thoroughly aroused, and the once timid fruit grower, who hesitated to request, now demands a "clean bill of health" with every tree he purchases.

In some instances, the inspection of nurseries is regulated by State laws, and in those States where such regulations are not upon their statute books, nurserymen are compelled, by public demands, to have their nurseries examined by competent persons every season. In other cases, the fumigation of the nursery stock, with hydrocyanic acid gas is required. Maryland has enacted such a law, and the Province of Ontario, Canada, has adopted the same system. It is useless for nurserymen to try to dodge the question, for the time has come when they must employ every possible precaution to prevent the further spread and distribution of certain insect pests. With the wide distribution of the San Jose Scale and the eyes of a critical world upon us, eternal vigilance must be the order of the day.

The Rural New Yorker, in a recent editorial says: "The time has come for nurserymen and tree planters to face the question of fumigating nursery stock. The San Jose Scale has been widely scattered. It is in many nurseries. We do not believe in trying to frighten fruit growers unnecessarily, but we do believe in facing the matter like grown-up men, and looking the danger fairly in the face. If a boy came into our orchard and cut down trees with an ax, we would not stand still and say that there was no danger. We would go where that boy came from and see to it that moral suasion, shingle or jail kept him away from the orchard in the future. The San Jose Scale is more dangerous than the boy, and more easily kept at home. There is no question about the value of hydrocyanic acid gas as a fumigator. \* \* \* It will cause nurserymen some trouble and expense, it is true, but in the end they will gain business by doing it. We think that it would

be better for nurserymen to recognize the justice and value of such fumigation, rather than to wait until they are forced to practice it."

The above quotation is so well said, further comment is not necessary in this place. I will now mention a few historical points about the gas itself, and then discuss the construction, management and operation of the fumigating house.

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### THE FIRST USE OF GAS TO DESTROY INSECTS.

The destructive and deadly properties of hydrocyanic acid gas upon insect life were discovered by Mr. D. W. Coquillett, an assistant of the Division of Entomology, United States Department of Agriculture, in 1886, while experimenting upon the Cottony Cushion Scale in orange orchards near Los Angeles, Cal. Three years later he perfected his system, and the gas has been used extensively in the orange orchards of California since that time for the destruction of the Black Scale and the Red Scale, both of which are very injurious.

Sprays could not be used, as they injured the fruit to such an extent that it was not marketable. The area in which this gas is most extensively used is covered by the seven counties of Southern California. Here the large orange orchards are fumigated regularly and systematically, by men who make a business of fumigating. As it is necessary to fumigate when the fruit is on, the work is done at night to avoid the burning effect of the gas upon the foliage when applied in the direct sunlight. The gas is also used to some extent in Florida, and, no doubt, in the near future will be more commonly used there, as the Red Scale is quite troublesome in many orchards. During the past two years the gas has been used quite extensively in Cape Colony, South Africa. In 1897 there was one outfit at work, fumigating a few citrus orchards; but in 1898 nine outfits, owned and managed by local organizations, were in the orchards, and about 27,000 trees were fumigated. The results have been very satisfactory, and other associations are being organized. I might say, also, that the nurserymen of the Cape are awake to their interests, and have constructed fumigating houses, many of them brick, for use in their business.

In Greenhouses.—Professor Albert F. Woods, Assistant Chief of the Division of Vegetable Pathology, U. S. Department of Agriculture, conducted the first successful experiments with hydrocyanic acid gas in greenhouses in 1894. At that time he fumigated a large greenhouse filled with ferns, infested with scale insects, killing all the creatures without the slightest injury to the youngest growing fronds. His next experiment was in a house containing about 20,000 coleus plants, many varieties, badly infested with the white-tail mealy bug, *Orthesia insignis*. All the insects were killed without injury to the

plants, much to the satisfaction of the owner, as he had exhausted every resource for their destruction, and was about to abandon the house.

Professor Woods and Mr. P. H. Dorsett, an Assistant of the Division, have since conducted many experiments, testing the effect of the gas upon various varieties of plants, and in the summer of 1897, made the most extensive application of gas ever made under cover. The houses fumigated contained 70,000 cubic feet of space, and about 10,000 violet plants badly infested with a black Aphis or plant louse were fumigated. This experiment was satisfactory in every respect, and the plants were completely rid of the pest.

Since 1897, the gas has been used quite extensively by florists and others in greenhouse work. Care must be taken, however, in applying it where a large variety of plants are in the same room, as some plants, for example, roses, are more easily injured by the gas than others.

**In Mills and Other Enclosures.**—The gas has also been used successfully in mills and other enclosures infested with insects and other vermin. The first test of the gas on a large scale was made in a Pennsylvania mill in June, 1899. Since then large mills in Ohio and Canada have been fumigated.

In South Africa it is used to fumigate railway coaches to free them from bed bugs. It can be used for many other purposes, among which might be mentioned, the chicken house, but be sure there are no chickens in it when the gas is generated.

**In the Nursery.**—The gas has been used for the fumigation of nursery stock for a number of years. So far as I can ascertain, it was first used for that purpose in California in the early nineties. It was scarcely known to nurserymen in Eastern United States until after the advent of the San Jose Scale in the summer of 1893.

From all information I have been able to gather, it appears that Prof. M. B. Waite, an Assistant in the Division of Vegetable Pathology and Physiology, United States Department of Agriculture, was the first to use the gas to fumigate nursery stock in the East. At his suggestion, a Virginia nurseryman adopted it, and a few months later Maryland was using it, incorporating fumigation in her State law in 1898.

There is no longer any doubt about the certainty of this method for the destruction of scale insects, and many other insects that infest nursery stock. In the fall of 1896, I fumigated with various strengths of gas a miscellaneous lot of trees, badly infested with San Jose Scale. They were set out and watched carefully during the season of 1897, 1898 and 1899, and not a living scale has been detected upon any of them. Other experiments were conducted in the spring and fall of 1897 and 1898, with the most gratifying results. I have had, there-

fore, a most excellent opportunity of making thorough and conclusive tests and after nearly four years' experiments and practical applications, have concluded that the gas method is the only practical one for nurserymen and dealers. At the same time, it is the least expensive of any of the methods now known, and the generation of the gas is so simple it can be handled by any nurseryman. The only requisites necessary for its successful application are (1), a good, tight box or house, (2) the chemicals and (3) proper application.

### THE NECESSARY EQUIPMENT.

The enclosures used for fumigating purposes are varied in size, to accommodate the grower, in accordance with the amount of stock



Fig. 1.—Tent for Fumigating Trees.

grown or handled. For illustration, we have one house that will hold from 12,000 to 15,000 first-class trees; and several, whose capacity is from 5,000 to 10,000. Others are smaller, holding from 1,000 to 4,000 trees, while small lots of a few hundred are placed in a box constructed for that purpose. In most of our houses the trees are put in by hand. One firm, however, handling from 1,000,000 to 2,000,000 trees annually, has two rooms large enough to admit a wagonload of trees at one time.

A good tent such as shown at Figure 1, can be used; but I do not advise it, as the cost would be equal to or in excess of a house of much greater capacity. There are also other objections to a tent; the first is that by constant use it is liable to become torn, and, secondly, and most important, the cubic capacity or space enclosed will vary with each lot of stock fumigated, unless a frame is used, and here lies the greatest source of error, as the chemicals, each time, must be weighed, after the calculation of the cubic contents. This danger of error is eliminated when a box or house is used, for it matters not whether one or a thousand trees are placed in the enclosure, the amount of the chemicals to be used remains constant.

### CONSTRUCTION OF THE FUMIGATING HOUSE.

Bear in mind from the beginning that the house is to be gas tight. It will, therefore, not admit of careless and indifferent workmanship. The work should be neatly done, the doors and ventilators fitting

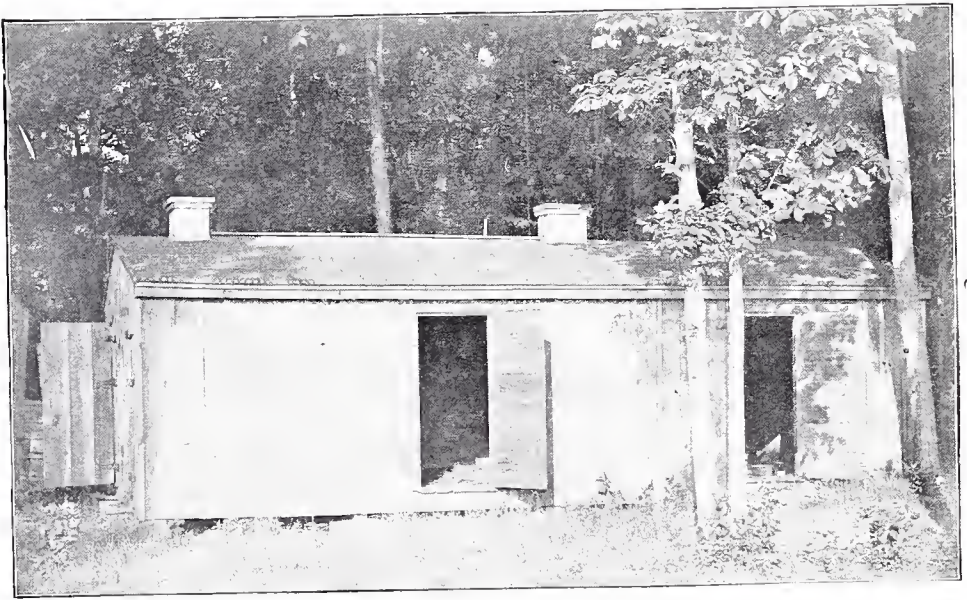


Fig. 2.—A convenient Fumigating House.

tightly. The lumber should be carefully selected, especially the flooring used for lining. It should be as free as possible from knots.

One of the largest fumigating houses in Maryland is shown in the illustration at Fig. 2. It is 32x16x8 feet, with a roof pitch of two feet, and is divided into two large rooms, 15x14x7 feet, and two smaller rooms, 4x5x7 feet, at the end. The flues leading out at the top of the roof are so arranged that they will ventilate either room by removing a slide. In addition to these roof flues there are also

two small doors,  $3 \times 2\frac{1}{2}$  feet, one for each large room, on the opposite side of the building, which, when opened, insures quick ventilation.

In the construction of this house, first a good strong frame was built and covered outside with  $1\frac{1}{4}$ -inch 12-inch Virginia pine boards,



Fig. 3.—Large House in which Trees are Fumigated on a Wagon.

and  $\frac{1}{2} \times 4$  inch battling. The interior, including the floor, was lined with two-ply cyclone paper, over which 4-inch flooring was laid. The roof was covered with heavy roofing paper, tarred and graveled. The



Fig. 4.—Two Fumigating Rooms built in end of Packing Shed.

doors are  $6\frac{1}{2} \times 3\frac{1}{2}$  feet, made double, refrigerating style, and hung with three heavy, strap-iron hinges. There should be a good strong bolt at top and bottom, and a lock in the middle of the door.

A fumigating house, the size of the one just described, is sufficiently large for a firm handling a million or more trees annually.

Another form, and very convenient house for firms handling a million or more trees, is shown in Figure 3. It is built in one end of the packing shed, and is 16x13x9½ feet. There is another room the same size on the opposite side of the building. These houses were constructed so as to admit a wagon load of trees at one time. While a load is being fumigated in one side, the other is being removed and everything is in readiness for another charge. These rooms are really too large, and it requires a great deal of cyanide to fumigate space not occupied by trees. For example, the space occupied by the wagon must be considered. The construction of this house is the same as the preceding, except that the roof is of corrugated iron and a clay floor.

Another type of house is shown in Figure 4. Here the two rooms are built in the end of the large packing shed. There are two doors, same size as those opening outside, leading into the packing shed. The rooms are filled with trees, and when fumigated and ventilated,

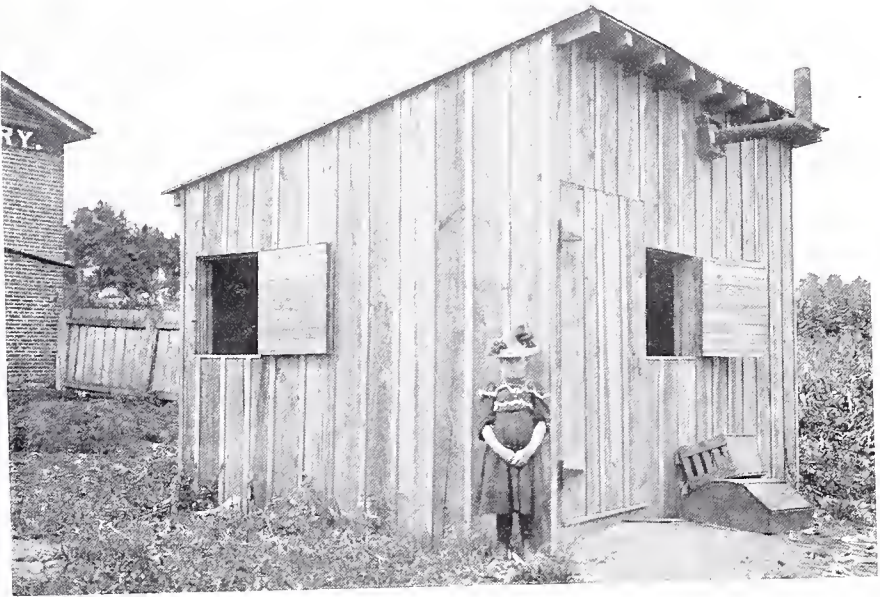


Fig. 5.—Single Room used in winter for grafting and other work.

by means of a large flue leading out the top of the roof, they are passed into the packing shed. This is one of the handiest and best constructed houses in the State.

A single room, suitable for a quarter to a half a million trees is shown at Figure 5. This house is constructed with sliding windows, in addition to the small doors. The flue is so arranged, it can be used as a chimney, if necessary, in winter. In fact, this is called the "handy house." In cold weather it is used for grafting, etc., and in summer, the little girl says, "it makes a lovely playhouse." The

room is 13x11x8 feet. Another single room of smaller dimensions is shown in Figure 6. This is also a very handy and neatly constructed house. It is 12x14x7 feet. It is sided up with first-class tongue and grooved flooring, instead of ordinary boards, and has a corrugated iron roof. There is also a small door in the opposite end, which has a sliding window inside. The house is large enough for a firm handling from a hundred to two hundred and fifty thousand trees or more.

One of the most convenient and economical houses in Maryland is the one illustrated in Figure 7. It consists of one large room, 10x8x7 feet, and two smaller rooms, each 4x4x7 feet. Only one of the smaller rooms is lined, while the other is used for a storeroom, in which all the chemicals and other materials are kept.

Instead of constructing a separate building for fumigating, very often a nurseryman has a packing shed or old building, in one end of which he can build his room. He can cover the frame inside with



Fig. 6.—A well constructed single room with corrugated iron roof.

boards; then put on three-ply cyclone or rawhide building paper, and finally the flooring. In every case, have a good smooth surface on which to secure the paper. The flooring can be joined very easily, and will be tight. The ceiling and floor should be lined and constructed in the same manner. In some cases, where a good solid clay floor can be had, as in Figure 3, it will answer the purpose, care being taken to see that the house is absolutely tight at the ground surface. As a rule, a ceiling seven to eight feet high is the most convenient and economical. If it is higher there is usually much space lost at the top of the room, adding to cost of chemicals.

The Box.—The size of the box used for fumigating purposes, of course, depends upon the amount of nursery stock grown or handled,

For my experimental work I have found a box 6 feet long, 3 feet wide and  $2\frac{1}{2}$  feet deep very satisfactory. It is made of common flooring and is double. Inside the boards run the long way, while outside they run cross-wise, which adds strength and stability. It is a simple, plain, open box, and when filled with young trees, kept in place by a couple of slats, it is turned bottom upwards and a little loose earth stamped about the edges. This makes a perfectly gas-proof box, and is all that is necessary for a nurseryman or dealer having a small trade.

Sometimes a large box such as is used for packing trees for shipment, can be converted into a temporary fumigating box. It should be first doubly lined with rawhide building paper and then covered with plain thin boxing.



Fig. 7.—A well-planned Fumigating House.

On the whole, I do not approve of the box, even for a nurseryman with a small trade.

A small room is infinitely better and about as cheaply constructed. It is secure, safe and always ready for operation.

**A Small Room a Necessity.**—Whatever the size of the nursery a small room, say 4x5x7 feet, is a necessity. Very often a small order, or a few trees to complete a big order, are needed quickly. It would be poor economy to use eighteen ounces of cyanide costing about forty cents to fumigate a handful of trees in a large room, when one ounce costing about two and a half cents in a small room would answer the purpose. It is not desirable, in most cases, to mix up small orders with car-load lots, and in most nurseries the small room will be found in almost constant use.

The plan of the house in Figure 7 is best suited for general work in the average nursery. The size can be increased to meet the demands of the individual, and, if necessary, the building lengthened and another large room added.

The kind, size, shape and location of the fumigating house rests with the individual, and he must be the judge as to what is best suited for his purposes, but the one thing he must remember all the time is that, whatever he constructs, it must be gas-proof. time is, that, whatever he constructs, it must be gas-proof.

### PREPARATION OF TREES FOR FUMIGATION.

The house having been constructed, the next step is the preparation of the trees for fumigation. They should be dug in the customary way, tied in loose bunches, brought to the fumigating house and piled loosely, not packed, on the floor, with roots toward walls and tops overlapping. When the desired number have been placed in the room they are ready for the gas. If only a small lot are fumigated they can stand up against the sides of the room.

How the Work is Done.—After the trees are dug from the nursery and loosely packed in the house either on end or flat on the floor, as noted above, the chemicals are then prepared and properly placed as near the center of the room as possible, after which the doors are closed and left for a half to three-quarters of an hour. A half hour is the minimum limit, but dormant trees are not hurt in the least if left an hour or longer. After fumigation, the trees are packed for shipment or heeled in on the yards.

The Chemicals.—The chemicals used are (1) cyanide of potassium, (2) sulphuric acid and (3) water. The cyanide must be practically chemically pure, guaranteed 98-99 per cent. It can be bought for about 30 cents per pound in bulk. The prices quoted us by the manufacturers\* vary from 30 to 32 cents per pound in bulk of 100 pound lots and from 32½ to 35 cents in smaller quantities, and are subject to advance without notice.

I find that cyanide broken into lumps about the size of shell bark hickory nuts gives better results and is more satisfactory to handle than large lumps. It can be procured in small lumps by notifying the manufacturer.

The best grade of commercial sulphuric acid (sp. gr. 1.83), should be used. A grade used ordinarily in the manufacture of fertilizer (chamber acid) will not do. I secured an excellent grade from the manufacturers at two cents per pound by the carboy. This substance is also subject to advance in price.

\*The Thomsen Chemical Co., Baltimore, Md., and the Roessler & Hasslacher Chemical Co., 100 William Street, N. Y.

Water from any ordinary well or cistern will suffice, the only requisite being that it should be clean.

Other Materials Needed.—There are several other materials needed for the work. (1) I find that pickle jars, holding from two to four quarts, are the best adapted for the chemicals, for the generation of the gas in most ordinary houses. Sometimes a large snuff jar is needed in such a house as shown in Figure 3. (2) A liberal supply of small paper bags holding a pound or less. The Cyanide is weighed out into the amount needed, placed in the bags and kept in an air-tight can, with screw top. *Caution:* Care should be taken not to weight too much cyanide at a time as the bags become saturated with moisture when the cyanide is long exposed to the air, and they are hard to handle. It is policy to weigh the material at night or early in the morning, or during the noon hour. (3) A graduated glass beaker, holding at least eight ounces, with ounces marked on the side, for measuring the acid and water. (4) A bottle with glass stopper, holding about two quarts for acid, or an ordinary china ware or glass pitcher will answer the purpose still better. (5) A pail for water. (6) A tin cup or glass for dipping water.

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### HOW THE GAS IS MADE.

In combining the chemicals, (1) measure the acid in the glass beaker (marked ounces), and pour it in the small earthenware crock or pickle jar; (2) measure water and pour this on the acid; (3) drop in a bag of cyanide, bag and all, which has been previously weighed, close door quickly, lock it and leave desired length of time. In the meantime, have the foreman in charge see that nobody enters or loiters about the house. When fumigation is completed, the doors should be opened by the foreman, and great care taken that nobody enters or goes near the house for at least ten to fifteen minutes.

Action of the Chemicals.—When the water is poured into the jar upon the acid, a slight evolution of steam arises, which is not dangerous, but as soon as the bag of cyanide is dropped in, there is a bubbling and sizzling, similar to that produced by a piece of red hot iron in cold water. There is also a dense cloud of so-called "steam" given off as long as there is any bubbling. This bubbling is due to the action of the acid on the cyanide, and the "steam" is the gas being produced. It has an odor somewhat similar to that given off by peach pits; but do not stick your nose over a jar or in a house to test it. These fumes inhaled would prove fatal, and thus the necessity of great care.

The Residue in the Jar.—After a charge of gas has been liberated in a house, there will be a residue left in the jar. At first, and while still warm, it is a whitish liquid, with a bluish cast, but as it cools

it becomes thick like paste, and crystalizes when cold. It is easily soluble in water. Immediately after the room has been ventilated the desired length of time, the foreman should empty the contents of the jar on a manure pile, or in a hole especially prepared for that purpose. As the acid and potash left behind are both excellent fertilizers they should be saved by composing them either with manure or dirt. Never pour the residue in an exposed place, where it would be stepped in.

**How Much Cyanide to Use and How it is Estimated.**—The amounts necessary for a room are estimated in terms of cyanide per cubic foot of space enclosed. For example, the large room shown in Fig. 7 contains 564 cubic feet. We use .25 (twenty-five-hundredths) gramme of cyanide for each cubic foot. We, therefore multiply 564 by .25. Thus,  $564 \times .25 = 141.00$  grammes of cyanide. To reduce this to ounces we divided 141.00 by 28.35, as there are 28.35 grammes in an ounce. Thus,  $141.00 \div 28.35 =$  ounces (a fraction less), the amount of cyanide needed for the house. The other chemicals are easily determined, as a half more acid, liquid measure, than cyanide, and a half more water than acid are used. Thus, the room needs five ounces cyanide (by weight),  $7\frac{1}{2}$  ounces acid (liquid measures), and  $11\frac{1}{4}$  ounces (liquid measure) of water.

As a rule, we discard any fraction less than a half. In this case, therefore, we would use 5 ounces of cyanide,  $7\frac{1}{2}$  ounces of acid and 11 ounces of water. The cost of chemicals, to fumigate this room, full of trees, would be about 11 cents.

The amount of cyanide needed for any room can be determined in the same manner. First, see to it that the cubic contents of the enclosure has been accurately computed, then multiply by .25 (twenty-five hundredths) and divide by 28.35, as indicated above, and you will obtain the correct amount. Always bear in mind that fumigation will admit of no guess work; successful fumigation depends on accuracy of application.

#### EFFECT OF THE GAS UPON VARIOUS GRADES AND KINDS OF NURSERY STOCK.

As no precise experiments had been carried on, so far as I know, to determine the physiological effect of this gas upon various kinds and grades of nursery stock, the writer began a series of tests early in 1899.

The experiments confirmed previous tests, that the gas, when used as recommended (.25 gramme per cubic foot), does not injure any kind of well-matured and dormant nursery stock. The tender terminals of peach in first-class stock were not affected in the least, until .45

gramme of cyanide, nearly double the normal dose, was used and exposed one hour. Apple was not affected, even where six times the normal dose was used; plum required nearly three times the normal to produce injury to terminals, while pear stood from three to four times the normal. All these exposures were for one hour, and the cyanide varied from .25 gramme to 1.45 grammes, adding .05 gramme each time.

**June Buds and Low-Grade Peach.**—We also determined by this series of experiments that June budded peach and low-grade peach trees, under three feet (better classed as whips), will not stand the gas stronger than .18 gramme. If, therefore, June buds and low-grade peach are to be fumigated, use the gas only two-thirds as strong as for other well-matured trees. The wood in June buds and low-grade trees is not well matured and more susceptible to the stronger dose of gas.

**Buds, Grafts and Cions.**—Some nurserymen do not want to take any chances whatever and fumigate every bud, graft and cion used, from whatever source. By taking this precaution, a great deal of trouble may be averted. As an illustration of the importance of this, I merely cite one instance. Two years ago, while inspecting one of our large nurseries, I noticed a box containing some apple buds from a Central-Western nursery which had been lately received, and upon examination I found these infested with the San Jose Scale. The few scattered scales would have escaped the eye of the nurseryman and would with great certainty have been budded into the nursery had they not been intercepted. By fumigating, even though they had been overlooked, the scales would have been destroyed.

A nurseryman can make almost any box perfectly tight by painting and papering it. In fact, a label box can easily be converted into a gas box. The chemicals necessary, can be easily calculated, when the capacity of the box is known, using .16 gramme (sixteen hundredths) cyanide per cubic foot. For example, say you have a box  $2 \times 2 \times 2\frac{1}{2}$  feet. This contains 10 cubic feet. Therefore,  $10 \times .16 = 1.6$  grammes (a very small fraction of an ounce), the amount of cyanide needed for the box. In this case the acid and water would also have to be estimated in cubic centimeters (designated c. c.) and not in ounces. We would, therefore, need 2.4 c. c. acid and 3.6 c. c. water for the box. These amounts are very small and the cyanide could not be weighed by the average nurseryman. It should be done by a druggist and each package wrapped in small papers ready for each application. The amount of liquid would be too small to be measured in the large beaker. Have your druggist measure out the desired amounts and pour in a small vial, marking the height of each (acid and water) on the outside.

A small tea cup can be used as a vessel for the chemicals when

put under the box. Leave exposed, at least, half an hour, and use the same precaution as cited for the house.

**Other Insects Killed.**—This gas readily destroys wooly Aphis so common and annoying on roots of young apple trees. Fall fumigation is most advantageous for the destruction of this pest. The black peach Aphis, on roots of peach, is also readily destroyed by fumigation, either fall or spring.

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### THE DEADLY CYANIDE AND GAS.

It must be remembered that potassium cyanide is one of the most deadly poisons known to chemical science, and that nothing is more destructive to animal life when inhaled than hydrocyanic acid gas.

When ventilating a house or box, care should be taken so as not to inhale the gas. The doors in a house in which gas has been generated should be thrown open and allowed to air, at least ten to fifteen minutes before any person is allowed to enter. This is a rule that must be strictly observed, otherwise life is endangered.

A fortunate accident happened in one of our fumigating houses two years ago which should be a signal warning to those who may use this gas. The house had been filled with Norway maple trees and after the usual length of time the doors were thrown open. At the expiration of seven minutes, a negro laborer, who was anxious to get away to attend a camp meeting in the neighborhood, and who had been repeatedly warned not to enter the room under ten minutes, went in and began handing out the trees to another negro who was standing at the door. He handed out two bundles and while stooping for the third, fell headlong to the floor. He was immediately pulled out, laid on his back in the open air, recovered consciousness in about fifteen minutes, and was seemingly as well as ever in half an hour. When asked what had happened and how he felt, he replied, "De Lord only knows, dat stuff am a powful axfitter."

It is needless to say that this negro, and no others on the place, have since entered the room under ten minutes after the doors were opened.

Another peculiar accident happened during our experimental operations. Our cyanide having been shipped to us in lumps too large for use, we found it necessary to break it up in smaller pieces. In order to do this and keep it from flying, we covered it with an old fertilizer bag. After the cyanide had been removed from the bag, and the smaller particles shaken out, the bag was again shaken out the window to free it of any particles that may have remained. As a result, a very few small pieces, not larger than a pin's head, were shaken on the ground. Two fine, large chickens, especially prized by their keeper, roaming about, picked up some of the cyanide, and in less

time than it takes to write this account, they were on their backs. One died in a very few moments, while the other recovered, evidently not having gotten so much.

Prof. Woods told me that a favorite cat, which was asleep under a bench in one of the greenhouses he fumigated, was killed without being awakened.

Frequently we place a worthless cat or dog in some of our houses, and they are killed where they stand.

The cyanide is pure white and resembles lump sugar or candy. It is such a deadly drug, a piece the size of a pin's head swallowed by a person would kill him almost instantly. A small piece of cyanide put in a piece of meat and laid for a cat or dog means sure death to the animal eating it. Cases are known where a cat died before she had wholly swallowed the meat. Rarely does the animal move ten feet from where the bait is eaten.

There is no more danger, however, in handling this gas than there is in gun powder, dynamite or gasoline, if proper precaution is taken. All of them are dangerous to life, but when cautioned, we handle them with impunity. I have heard of no serious accidents from the use of this gas, but bear in mind all the time that this deadly cyanide and the terrible gas generated from it will admit of no carelessness and indifference.

#### Some Points to Remember.

1. Never let a tree grown by you get out of your hands unless you have fumigated it.
2. Never fumigate a tree on which you know there is a San Jose Scale. The furnace and not the fumigating house is the place for such trees. A dead scale on a tree is just as demoralizing to your business as a live one, if seen by the buyer.
3. Never use the gas stronger than .25 gramme cyanide per cubic foot on any kind of nursery stock.
4. Never leave the trees exposed to the gas longer than an hour.
5. Never fumigate trees, especially peach, a second time.
6. Never fumigate trees in a car after it is packed.
7. Never fumigate trees when they are drenching wet. They may be moist, even quite damp.
8. Never puddle the roots of trees before they are fumigated.
9. Never fumigate cedars and evergreen trees, unless there is some special cause for it.
10. Never fumigate trees until the wood is well-matured and the buds thoroughly dormant.
11. Never fumigate after the buds have begun to open in the spring.

12. Never fumigate June buds and peach under three feet, with gas stronger than .18 gramme cyanide per cubic foot. Better use .16 gramme.

13. Never fumigate buds, grafts or cions with gas stronger than .16 gramme.

14. Never leave the cyanide can where children can reach it.

15. Never let the cyanide can be without a conspicuous label  
POISON.

16. Never leave the cyanide exposed to air. It will absorb moisture and ruin it.

17. Never take a bag of cyanide out of a can, until you are all ready to use it.

18. Never leave the door of the fumigating room open a moment after the cyanide has been dropped in the jar.

19. Never allow a person to go near or open the door when fumigating.

20. Never allow anybody to enter a room under ten to fifteen minutes after the door and ventilators are open.

21. Never empty residue of jar where children would play in it.

22. Never allow residue to remain long in the jar.

23. Never put a new charge in a jar containing the old residue.

24. Never put sulphuric acid in tin or iron vessels; it will eat them up. Always use glass or earthenware.

25. Never lose an opportunity to caution persons in your employ or on your place about the danger attending the inhalation of this gas.











